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The Economic Cost of Armed Conflict

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Abstract

This paper estimates the distribution of the effect of armed conflict on real GDP per capita and investment. For each conflict, we construct a synthetic control from a set of conflict-free countries that closely resembles the conflicted country in the pre-conflict period. The economic evolution of this counterfactual country is then checked against the real evolution of the treated country to measure the GDP and investment gap that occurs during the conflict and post-conflict periods. We find that the size of the effect of armed conflict is very heterogeneous and varies widely depending on the type and intensity of the conflict episode being analyzed, as well as the number of years after onset. Conducting the analysis in levels instead of growth rates reveals that there is an economic loss even when there is a peace dividend effect. Our empirical exercise also serves as an illustration of a procedure to estimate the distribution of a heterogeneous treatment effect by means of the synthetic control method.

Keywords: armed conflict, case study, synthetic control, treatment effect

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1 Introduction

There is an interest in trying to measure as accurately as possible the effect of armed conflict on a nation's economy: since armed conflict has severe developmental consequences, doing so could help understand past conflicts, their economic consequences and explain how nations might react to future war episodes (Gates et al, 2012). However, measuring the economic cost of armed conflict is difficult. It amounts to estimating how much income would a country or region have obtained, had it not experienced an armed conflict episode. In this paper, we construct such a counterfactual estimate of the economic cost of conflict using a quasi-experimental method: the synthetic control.

Researchers have used different methodologies to measure the economic effect of armed conflict, as shown in Gardeazabal (2012). These methods can be broadly classified in two approaches: cross-country studies, e.g. Caplan (2002); Murdoch and Sandler (2002); Koubi (2005); Glick and Taylor (2010); Gates et al (2012), and single country case studies, e.g. Arunatilake et al (2001); David et al (2009); Camacho and Rodriguez (2013); Serneels and Verpoorten (2015); Frontier Economics (2015). In a leading example of the cross-country approach, Collier (1999) estimated that during a civil war the annual growth rate is reduced by 2.2 percent. This estimate is an average, but it stands to reason that the effect varies depending on other characteristics such as conflict type, intensity and period. Conflicts of different nature are likely to have varying effects, e.g. Blomberg et al (2004) find that terrorism has a significantly negative effect on growth, but this effect is considerably smaller than that associated with both internal and external wars. The intensity of conflicts is also important, e.g. Martin et al (2008) show that civil wars have a very large and persistent negative effect on international trade, and this effect increases with the intensity of the

conflict. The economic cost of armed conflict is also likely to be different right after the armed conflict breaks out, than during the battle period or the aftermath. Nonetheless, cross-country estimates do not usually account for time varying effects. An exception is Collier (1999), who estimated not only the economic cost of civil war, but also the post-conflict peace dividend. Other recent contributions to the cross-country literature of armed conflict include Peace (2015); however, they focus on estimating the cost of violence containment (i.e. the costs related to armed conflict prevention), not the actual costs that armed conflict generates in terms of GDP loss.

Traditional case study methodologies also have its disadvantages, though. Case studies on the cost of conflict often use the cost-accounting method, which adds up the monetary value of both direct and indirect costs of the conflict, thus requiring all costs to be exhaustively listed and inspected so as to avoid double accounting, e.g. David et al (2009); Bilmes and Stiglitz (2012). Other case studies, e.g. Anderton and Carter (2001); Lopez and Wodon (2005), use time series methods to estimate the economic cost of armed conflict. However, because these methods only use data of the conflicted economy, the resulting estimates do not have a causal interpretation, since the counterfactual evolution of the GDP of the conflicted economy might have been influenced by business cycles or shocks affecting the conflicted economy as well as others in the region or the entire world. An exception to these problems is Camacho and Rodriguez (2013), who are able to obtain causal effects of armed conflict in Colombia by using panel data and a fixed-effect estimation.

Our approach avoids the obstacles of estimating a cross-country average and grouping together different types of conflict by focusing on a particular conflict and estimating its effects on an individual basis: to overcome the mentioned shortcomings, we use the synthetic control method, e.g. Abadie and Gardeazabal (2003); Abadie et al (2010); Hainmueller et al

(2014, Forthcoming). This methodology is a particular way of carrying out a comparative case study using a quasi-experimental approach. We will refer to countries as units, armed conflict as the treatment and the real Gross Domestic Product (GDP) per capita and Investment as the outcome variables. The synthetic control method estimates the effect of a treatment on the outcome of interest for a single unit, i.e., we will apply the synthetic control method to each conflict individually.

Note that although in a traditional comparative case study, the treated unit is compared with a handful of control units. However, it is often the case that no single untreated unit can serve as a good control: this is where the synthetic control, a weighted average of the untreated units, may serve the purpose. That is, the idea is to compare the GDP of a country that underwent an armed conflict with the GDP of a synthetic control constructed as a weighted average of countries that did not experience an armed conflict during the same period. The synthetic control method has been previously used to estimate the economic effect of terrorism: Abadie and Gardeazabal (2003) found that the terrorist conflict in the Basque Country had a negative impact on the economy; on average, a 10 percent gap between the actual per capita GDP of the Basque Country and that of a comparable synthetic control region. The paper by Abadie and Gardeazabal (2003) paper, however, focuses on a single case study of the effect of terrorism, whereas our main contribution in the present work will be to obtain the *distribution* of the effect of armed conflict. We will do so by applying the synthetic control method reiteratively to all the armed conflict episodes that have occurred since the mid-1950s. This will also be the main distinguishing point between our work and other recent ones in the literature that deal with a similar topic using the same methodology (e.g. Bove et al, 2014; Steele, 2014). Both papers use the synthetic control method to measure the effect of armed conflict on GDP, however, they only consider a sample of twenty-something civil

wars; whereas we include all types of conflict in our analysis and our sample of conflicted conflicts is much larger. Furthermore, we also analyze the effects on investment and, most importantly, our main objective is to obtain a time-distribution of the effect of armed conflict, which they do not focus on.

Therefore, notwithstanding the importance of other effects such as psychological and welfare costs e.g. Skaperdas (2011), in this paper we focus on estimating the economic costs of armed conflict measured by the real GDP per capita loss as well as Investment loss.[1]

As a starting point in the path to our main objective, we initially focus on two example cases in order to measure the economic costs of two different types of armed conflict: a civil war (Sierra Leone, 1991-2002) and a war (mostly) fought on foreign soil (Israel, 1965-1967). The economic evolution of each conflicted country is checked against the evolution of a synthetic control region constructed as a combination of countries that have not suffered from an armed conflict and that economically resembles the conflicted country before the conflict onset. We find that in the case of the Sierra Leone civil war, there is on average a 42 percent loss of real GDP per capita with respect to the synthetic control while in the Arab-Israeli conflict of 1965, the real GDP per capita of Israel is on average 5 percent lower than its synthetic control. Furthermore, Israel seems to return to its counterfactual growth path soon after the conflict ends, whereas in the case of Sierra Leone, it appears as if the path has changed permanently due to the war.

We further explore this large disparity in the size of the effect of conflict by calculating

[1] It is worth noting that, because the estimated effect is measured on the outcome variable real GDP per capita, the measure does not include the destruction of capital (but it does account for the value of foregone goods and services derived from that capital diminishment). This accounting problem is nevertheless not specific to the method used, but that it applies to any method using GDP data, because the issue stems from how the GDP is measured.

a measure of the distribution of the effect of armed episodes on both real GDP p.c. and on Investment. This is done by applying the synthetic control method to as many conflicts as the data available allows, and keeping those that have a good match and are statistically significant to estimate the distribution of the effect of conflict. [2] We find that the effect of conflict indeed varies widely not only among different types of conflict, but that there is also a significant variance between conflicts of the same type, which justifies the use of the synthetic control method. We also analyze the distribution of the effect as the years after conflict onset elapse.

The paper is organized as follows. Section 2 is a brief overview of the synthetic control method. Section 3 explains the datasets used to conduct the application. Section 4 describes the application of the method to two specific cases, the civil war in Sierra Leone (1991-2002) and the Arab-Israeli war (1965-1967). Sections 5 and 6 consists of the application of the method to all the possible conflict episodes and the calculation of the distribution of the effect of conflict on real GDP p.c. and Investment respectively. Section 7 concludes.

2 Applying the synthetic control method

Assume we observe $J+1$ countries over periods $t = 1, ..., T$. The first unit is affected by an armed conflict, uninterruptedly, after an initial intervention period $T_0 \in \{1, ..., T-1\}$. The remaining J units serve as potential controls or "donor pool". Let Y_{jt} denote the (log) real GDP per capita of country j at period t. The effect of the armed conflict on (log) real GDP per capita, α_{1t}, is measured as the difference between the observed outcome variable Y_{1t} and

[2] Nevertheless, the synthetic control method cannot be applied to every conflict as it requires enough data and a good match among the pool of control countries, which is often not available.

the outcome variable of the synthetic control, which is estimated as

$$\widehat{\alpha}_{1t} = Y_{1t} - \sum_{j=2}^{J+1} w_j Y_{jt}, \tag{1}$$

for the post-treatment period $t = T_0, T_0+1, ..., T$ and where the $(J \times 1)$ vector of weights $\mathbf{W} = (w_2, ..., w_{J+1})'$ is calculated in such a way that it minimizes the distance

$$\sqrt{(\mathbf{X_1} - \mathbf{X_0}\mathbf{W})'\mathbf{V}(\mathbf{X_1} - \mathbf{X_0}\mathbf{W})},$$

subject to $w_j \geq 0$ for all $j = 2, ..., J+1$ and $\sum_{j=2}^{J+1} w_j = 1$. In the above equation, $\mathbf{X_1}$ denotes a $(K \times 1)$ vector of pre-treatment values of K economic growth predictors for the treated country, $\mathbf{X_0}$ is a $(K \times J)$ matrix that contains the values of those same growth predictors for all possible controls, and $\mathbf{V}$ represents a diagonal matrix with non-negative elements that reflects the relative importance of the predictors and is estimated in such a way that the outcome variable of the treated country is best reproduced by resulting the synthetic control (see Abadie and Gardeazabal, 2003, for more details). We will refer to the diagonal elements of $\mathbf{V}$ as "predictor weights".

Therefore, the synthetic control is constructed as a convex combination of the countries in the donor pool and it is, out of all the feasible synthetic controls, the one that most closely resembles the economy of the conflicted country in the pre-treatment period according to some measure of the gap between growth predictors of the conflicted country and those of the synthetic control.

In order to assess the statistical significance of our estimates, we conduct a placebo study applying the same procedure that was used to estimate the GDP gap of the conflicted

country to all the J countries in the donor pool. That is, for each country in the donor pool a synthetic control is constructed using the remaining countries in the donor pool and each GDP gap is estimated. The idea is that, if the results we had obtained were simply a byproduct of a bad matching, we should observe something similar for other countries in the donor pool. Conversely, if the results we have are very different from the results obtained for the other countries in the donor pool, we can conclude that the gap in GDP is statistically significant.

Equation 1 provides an estimate of the economic cost of conflict for a single conflict episode. To obtain an estimation of the distribution of the economic effect of conflict we repeat the same procedure with every possible armed conflict episode in our database. Note that the donor pool will be different for each armed conflict episode.

3 The data

Data on the outcome variables, real GDP per capita and Investment are obtained from the Penn World Table (PWT), a panel dataset for 189 countries that ranges from 1950 to 2009. Starting and ending dates of conflicts are obtained from the Uppsala Conflict Data Program and the Peace Research Institute Oslo (UCDP/PRIO) Armed Conflict Dataset. The PRIO database indicates that out of those 189 countries, 103 have had an armed conflict at some point between 1950-2009. This means that we have 86 potential controls. In practice, however, the pool of donors will be reduced due to lack of available data on the outcome and covariates. The PRIO database codes different "start" dates for each conflict: date of incompatibility goals, date of first weapon used, date of first death and date of first twenty-

five deaths. In most cases, there is a distinctive lag between the incompatibility and the actual start of the armed conflict. The last three dates are usually within the same year. We will use date of the first 25 deaths as the start of the conflict in our research. The dataset also includes information on the type of conflict, which can be either Extrasystemic (war fought outside of the country), Interstate, Internal without external intervention (Civil War), or Internal with external intervention. Data on the intensity of the conflict is taken from the dataset by the Center for Systemic Peace and is a variable coded on a 1 to 10 scale, with 1 being the least intense or damaging ("Sporadic or Expressive Political Violence") and 10 being the most intense ("Extermination and Annihilation"); although conflicts in our sample range from 1 to 7 only. The level of intensity is determined by a series of indicators, which include direct and indirect deaths, injuries, population dislocations, damage to societal networks and infrastructure, destruction of the environment and ecosystem, and other tangible and intagible losses.

For the synthetic control to work it must closely resemble the most important economic characteristics of the conflicted country that is being studied. With this goal in mind, we have considered as important economic characteristics the following growth predictors: Investment Share of Real GDP Per Capita, Degree of Openness, Population Density, and Primary and Secondary Educational Attainment. These covariates are the classic ones used in economic growth models. Data on all of these variables come from a variety of sources, which are specified together with their definitions in the Appendix. In addition, we have also considered the pre-treatment values of the real GDP per capita and its average as additional covariates (see e.g. Abadie et al, 2010, on the use of pre-treatment values of the outcome variable to obtain a good control).

Given that our goal is to measure of the effect of armed conflict for different cases to

check how heterogeneous the costs are, we would ideally study all 103 conflicted countries in the PRIO database. Unfortunately, it is not feasible to use this method with all of them. This is due to three major reasons: there is no data available either for the outcome variable or the covariates, there are not enough years in the pre-treatment period, or the method can be applied but the matching in the pre-treatment period is not good enough, hence the results can not be interpreted. For similar reasons –mainly due to lack of available data– we do not use all of the 86 potential controls, though this is determined on a case by case basis: in each case, we use as many potential controls as possible.

In the following section, we focus our attention on two specific cases, which are also two different types of conflict: the Sierra Leone civil war and the 1965-1967 Arab-Israeli interstate war. These two applications serve as an illustration that the costs of conflict are, indeed, heterogeneous. We then move on to calculate an estimate of the distribution of the effect, by applying the method to as many cases as possible (82 out of the 103 coded conflicts).

4 Two conflict examples: Sierra Leone and Israel

4.1 Historical background

The Sierra Leone civil war began in 1991 when the rebel Revolutionary United Front (RUF) attacked Sierra Leone in an attempt to bring down the Government led by Joseph Momoh. The initiative resulted in an nine year long civil war that encompassed the whole country and ended with more than 20,000 human casualties (although estimates are as high as 75,000), one third of the population displaced, a third of the country's towns ruined, and almost

all institutions completely destroyed. In short, it was one of the most violent civil wars in history. Unlike other civil wars, which are fought over ideology, this one was fought largely based on economic resources and maintaining control over the diamond trade.

After the initial attacks by the RUF on March 1991 and over the next six years, both sides fought to maintain control of the diamond industry with varying degrees of success. At the start of 1999, UN intervened, and the Lome Peace Accord was signed two months later. The pact gave the RUF control over the diamond mines in return to bringing the war to a halt.

Taking into account the historical background –no previous or posterior wars in the country, minimal foreign intervention to declare the end of the war– the case of Sierra Leone seems like a good example to measure the effect of a civil war and the synthetic control method seems applicable.

On the other hand, the Arab-Israeli conflict of 1965 was fought by Israel and its neighboring countries Egypt, Jordan, and Syria. The conflict began in 1965 with the first battle related death and culminated two years later in 1967 with what is known as the Six-Day War, which took place on June 5-10.

This conflict was the third major Arab-Israeli conflict; and in a sense, a continuation of the previous two, which took place in 1948 and 1956. The Arab refused recognition of Israel as a state, and in the early 1960s, Syria began to sponsor guerrilla raids on Israel. In 1964, Israel began to draw water from the Jordan River for its National Water Carrier, which reduced the flow that reached the Arab states. The Arab states retaliated with the Headwater Diversion Plan, which, once it was completed, would reduce Israel's water supply by approximately 11%. As a result, the Israel Defense Forces (IDF) attacked the construction

of the diversion in Syria in March, May and August of 1965, year that marks the beginning of the conflict in question with the first series of battle-related deaths. On June 5th, 1967 Israel launched Operation Focus, a surprise strike that marked the beginning of the Six-Day War.

The war ended with more than seven hundred deaths and more than 2,500 injured on the Israeli side. On the Arab side, the death toll was approximately 15,000 Egyptians; 2,500 Syrians and 800 Jordanians, although estimates vary greatly. As a result of the war, Israel tripled its territory, placing about one million Arabs under its direct control. This caused a wave of displacements: approximately 300,000 Palestinians left the newly occupied territories and most settled in Jordan.

Even though there might be discrepancies as to when the conflict actually began, we have taken into account that the PRIO database states 1959 as the year the incompatibility started; and 1965 as the year when the conflict became armed and the threshold of twenty-five human casualties was reached. We believe that the year both parties began using arms and deaths first happened are the most significant in terms of when the conflict started; and as such, we will use it as the conflict onset in our analysis.

Given this historical context, using the Israeli conflict as an example of a war fought in foreign soil (or Extrasystemic) seems appropriate. Furthermore, Israel has not suffered from another conflict in the pre-treatment period, which ranges from 1957 to 1964. The post-conflict period (1967-1975) includes two armed conflict episodes, the War of Attrition (1967-1970) and the Yom Kippur War (October 1973), which are relatively minor as compared with the 1965-1967 conflict. Therefore it is fair to say that the dose of the treatment decreases after 1967.

4.2 Empirical results for the two applications

We construct the synthetic controls for Sierra Leone and Israel as a convex combination of countries that have had no armed conflicts during the period of analysis; that is, countries that are in the donor pool.[3] These two synthetic controls are, out of all the feasible synthetic controls, the ones that most closely resemble Sierra Leone and Israel respectively in terms of the determinants of log real GDP per capita in the corresponding pre-treatment period, 1970-1990 in the case of Sierra Leone and 1957-1964 for Israel. The determinants include those discussed in Section 3, which are all variables commonly used in economic growth models; plus the mean value of the outcome variable (log real GDP per capita) averaged over the pre-treatment period.

Table 1 reports the actual economic characteristics and the synthetic controls for Sierra Leone and Israel, as well as the sample mean of the countries in their respective donor pools and the weight corresponding to each predictor variable. In general, the synthetic control has covariate values closer to the actual ones than the sample averages, especially for the covariates with a heavy weight. The average pre-treatment real GDP per capita has the biggest weight, human capital proxies have small weights, while the investment share of real GDP, the degree of openness and population density have almost no weight or no weight at all.

On the other hand, Table 2 reports the weight each country in the donor pool has in the synthetic control, both for Sierra Leone and Israel. Results show that the pre-conflict GDP of Sierra Leone is replicated in more than 90% with a combination of Benin and Malawi; whereas Israel is replicated in 80% by Japan, Brazil, Luxembourg, Iceland and Norway, in

[3]We use the Synth package for R developed by Hainmueller et al (2011).

decreasing order of importance.

Figures 1 and 2 show the log real GDP per capita of Sierra Leone and Israel and their respective synthetic controls. The vertical lines correspond with the beginning and end of the conflicts. The synthetic controls reproduce the actual evolution of the real GDP per capita of Sierra Leone in the pre-war period fairly well, and particularly well for the case of Israel. When the conflicts begin, the actual real GDP per capita of both countries experiment a sharp drop. In the case of Sierra Leone, actual real GDP per capita never catches up to its synthetic control, while in the Israeli case real GDP per capita does catch up to the counterfactual. The effect of the armed conflicts on real GDP per capita is given by the difference between the actual and synthetic values, the shaded area in Figures 1 and 2. Notice that the effect of the conflicts extends through both the conflict and post-conflict periods as well.

In order to assess the statistical significance of our estimates, we conduct a placebo study by applying the same procedure that was used to estimate the GDP gap of the conflicted country to all countries in the donor pool. That is, for each country in the donor pool a synthetic control is constructed using the remaining countries in the donor pool and each GDP gap is estimated. Since the countries in the donor pool have not suffered from an armed conflict, if the results of our case study are very different from the results obtained for the other countries in the donor pool, we can conclude that the gap in GDP is significantly different from the gap obtained for countries which did not experience an armed conflict during the same period. However, if the results were just due to a bad matching and not the effect of the armed conflict, one should observe a similar pattern for other countries in the donor pool.

Figures 3 and 4 show the GDP gap of Sierra Leone and Israel respectively, as well as the GDP gap of the countries in the donor pool that have a MSPE no higher than twice for Sierra Leone and five times their MSPE for Israel obtained during the pre-war period, where the MSPE is defined as

$$MSPE = (T-1)^{-1} \sum_{t=1}^{T-1} \left(Y_{1t} - \sum_{j=2}^{J+1} w_j Y_{jt} \right)^2 ;$$

that is, the average of the square of the difference between the actual and the counterfactual outcome over the pre-treatment period. Note that excluding countries with higher than a certain MSPE is done to ensure that the countries undergoing the placebo study have a good match in the pre-treatment years. In the case of Sierra Leone, the graph includes 17 placebos and its estimated post 1991 gap is one of two outliers, the other one being Mongolia which does not have any weight in the synthetic control.[4] In the Israeli case, ten control countries besides Israel remain in the figure, out of the initial sixteen controls. Between 1965 and 1970, i.e. in the war and immediate post-war period, Israel's gap is a definite outlier, thus suggesting that our estimate of the effect is statistically significant.

According to Table 3, between 1991 and 2009, the mean annual loss as a percentage of the actual real GDP per capita in Sierra Leone is 41.67 percent while the average yearly loss for Israel is 5.30 percent (1965-70). The time pattern of the loss can be described as an initial period of increasingly large loss followed by a so called "peace dividend" whereby the real GDP per capita grows at a higher than normal rate, although in the case of Sierra Leone the peace dividend accrues even before the actual end of the conflict.

[4]See Table 2. Incidentally, in 1992 Mongolia underwent a political regime change that might explain the sudden drop in its real GDP per capita.

Comparing the results obtained for the two case studies, we see that the effect of conflict is completely disparate. In the case of Sierra Leone, one of the cruelest civil wars in history, the average size of the effect is a yearly loss of 41.67 percent in real GDP per capita, and it reaches a maximum of 107.10 percent loss in 1999. It is therefore eight times bigger than the average effect for Israel; which is 5.30 percent between 1965 and 1970, with a maximum loss of 15.14 percent in 1967. Considering the type of conflicts studied (Internal without external intervention and Interstate, as coded in the PRIO database) it definitely makes sense for Sierra Leone to have the highest effect and for Israel to be less affected, since the war is fought outside of the country's soil. Also note how Israel seems to catch up to its counterfactual path very quickly, as if the conflict makes the economy deviate from its growth path only slightly, whereas Sierra Leone seems to permanently deviate from its counterfactual growth path. This disparity in the size of the effect of conflict on a country's economy makes estimating the overall effect of conflict difficult, reinforcing the idea that a case-by-case approach seems more appropriate than a cross-country analysis, and serves as the basis for the next section of the paper.

It is also interesting to notice *when* the maximum size of the effect is reached. Sierra Leone's worst year in terms of per capita GDP loss is in 1999, just as the United Nations decided to intervene. In the case of Israel, the maximum happens in 1967, when the conflict culminated in the Six Day War. We can see in Table 3 that in both of these cases the gap exhibits a pattern of peace dividend effect, since the growth rate gap is negative in the conflict period and positive in the post-conflict period. Both the timing of the maximum effects and the existence of a peace dividend effects are consistent with the idea that the real GDP per capita gap observed in these cases is attributable to the effect of the armed conflict, i.e. there is a causal relationship.

Nonetheless, if we turn our attention to the real GDP per capita gap in levels rather than growth rate the story is different. Table 3 shows that the gap is negative in both the conflict and post-conflict periods. Even though the growth rate gap is positive in the post-conflict period, there still exists a quite large loss in the post-conflict period. One might miss this if they were to conduct this analysis using growth rates instead of GDP levels, as is the case with most cross-country analyses.

5 The distribution of the effect of conflict on real GDP per capita

Section 4 shows how two different conflicts have vastly different effects on GDP. However, these are just two very specific cases, and we can not extrapolate the results obtained to other conflict episodes based on solely these two examples. Thus, in order to have a broader idea of how conflict affects real GDP p.c., we apply the same methodology to as many conflicts as we can and analyze all the results together. This gives us an estimate of the distribution of the effect of armed conflict on real GDP per capita. By applying the synthetic control method to the universe of armed conflict episodes that took place over the last decades, we are able to estimate the distribution of the economic effect of armed conflict and therefore asses how heterogeneous the effects are unlike with more traditional treatment effect methodologies, which focus on average treatment effects. This way of obtaining a measure of the distribution of the effect also has the advantage that, unlike traditional methods, it does not force the treatment effect to be constant, but instead allows you to check the evolution of the effect over time. Furthermore, we are able to determine the statistical significance of the effect of

conflict on a case by case basis, instead of determining significance of the average effect.

The main obstacle when attempting to do this is that there are not enough data on the covariates. Nevertheless, the results reported in Table 1 show that the most important variable in the counterfactual is in fact the average pre-treatment values of the outcome variable (real GDP per capita).[5] Therefore, given the lack of covariate data but the fact that the pre-treatment values of GDP do a good job on their own of replicating the conflicted units in the treatment period, we decided to conduct this part of the analysis using only pre-treatment values of the outcome variable as (special) covariates. This allows us to construct a synthetic control for 82 out of the 103 conflicts coded in the PRIO database. The remaining 21 do not have enough pre-treatment periods with available data on GDP. For each case, we take the largest number of pre- and post-treatment periods possible, up to ten. As a result, the pre-treatment period ranges between four and ten years, and the post-treatment period (which includes the start of the conflict itself) ranges between eight and ten years, depending on the available data and the specific conflict episode. We do the matching on the pre-treatment values of the real GDP per capita and measure the effect of conflict on the post-treatment real GDP per capita. Initially, all armed conflict-free countries (86 total) are included in the donor pool as possible controls; however, this number is reduced in some cases if there is no data available, particularly for the earliest conflicts from the 1950s or 1960s. For each conflict we include the maximum number of controls possible.

Therefore, a synthetic control is estimated for each one of the 82 conflicts. Out of those 82 conflicts, 18 of them are discarded because of a bad match, i.e. they have a high MSPE

[5]Although not shown, we also applied the synthetic control using several (and all) of the pre-treatment values of real GDP per capita besides the growth determinants as predictors, and the match improved significantly for the case of Sierra Leone. Furthermore, the weight of the traditional growth determinants was reduced almost to zero in this case.

that makes the result unusable. As a threshold to determine a good or bad match, we keep the countries with a MSPE lower than 0.05.[6] For the remaining 64 conflicts, a placebo study is carried out with the corresponding controls and it is determined whether the conflict has a significant effect or not. Out of the 64 conflict episodes, 49 significant (in at least 3 periods) conflicts remain. For this application and in the next section, given the volume of cases, the significance of the treatment is determined in an automated way, calculating for each conflict episode the ratio of each period in the post-treatment RMSE relative to the pre-treatment RMSE for the treated unit and the controls, and checking whether the ratio of the treated unit is an outlier for each period, in a similar way Hainmueller et al (2014, Forthcoming); and where RMSE is defined as the square root of the MSPE previously defined. The only difference with respect to them is that we have a RMSE ratio for each period in the post-treatment period; since several conflicts had significant effects in the first few years post-treatment but not all of them, this was a way to determine in which periods exactly was the treatment significant.

Table 4 shows all conflicts to which the method is applied, together with the date of the start of the conflict, the duration of the pre- and post- treatment periods, the type of conflict, the intensity, whether the match on real GDP was good or not, and whether the effect of conflict on real GDP is found to be significant or not according to the placebo studies. [7]

The gaps –the difference between the actual log real GDP per capita and the estimated counterfactual – for the 49 conflicts that have a good synthetic control match and are significant are computed and plotted in Figure 5. For each country, the conflict onset is considered period zero, and the number of years is measured relative to the conflict onset: a positive

[6] As a reference, the application for Sierra Leone had a MSPE of 0.04 as seen in Table 1.

[7] Note that the Spanish conflict to which we refer is the Ifni war from 1957, and not the terrorist conflict; therefore it does not refer to the findings of Abadie and Gardeazabal (2003).

number of years denotes years after conflict onset, while a negative number of years means we are looking at the pre-treatment period. Since the data is all measured in international $ from 1996, it is possible to make this comparison of the gaps across countries. Given that a loss of, for example, 1000 Intl $ is not the same for all countries, the relative gaps –measured at each year as the gap between real GDP p.c. and the synthetic control in real GDP p.c. terms divided by the real GDP p.c. times 100– are also computed and plotted in Figure 6. Both Figures 5 and 6 are very similar; though the scale does change.

Although Figure 6 shows that the effect of conflict is unmistakably significant, heterogeneous, increasing as years go by since onset and –as one would expect– mostly negative, a small number of cases appear to have a positive effect in at least some of the periods. That is, the method predicts that the economy has actually benefited from the armed conflict episode and has a higher real GDP p.c. than it would have in the absence of conflict. This result, although somewhat unexpected, is perhaps not as surprising as one might think on first instance. Not only are there previous articles with similar findings (see Guidolin and La Ferrara, 2007, 2010; Berrebi and Klor, 2010); but when inspected further, all except one of the conflicted episodes that the synthetic control method has predicted with a positive effect in some of the post-treatment periods fall under one of the following categories: the positive effect comes after or prior to a strong negative effect, or the years in which the effect is positive are found to be non-significant.

Figure 7 shows the relative real GDP p.c. gaps for conflicts that have a positive effect on some of the post-treatment periods. Out of the four countries shown, most of them (Central African Republic, Nicaragua, and Peru) only have a positive effect in the first one or two years of the post-treatment period we have considered: a slightly positive effect takes place in the first years post-treatment, followed by a sharp drop. Hence we could say that, whereas

most of the studied cases suffer the effect almost immediately (or in the year or two following the conflict onset), in the case of those three countries there is a delay in the effect. Unlike the remaining cases, Egypt has an unmistakably positive effect in all of the periods considered, which could be due to an increase in Government expenditure in order to finance the war against Islamic militants. Note the importance of these positive effects for several conflicts in at least a few of the post-treatment periods considered: other traditional methods that calculate an average treatment effect could very well be "hiding" part of the effect if it turns out that for some of the treated units, the effect is positive instead of negative.

Another important aspect is that when determining the significance on a case-by-case basis, we were able to discard conflicts that had an estimated positive effect, but turned out to be non-significant. With average treatment effects, this analysis is impossible to conduct, and might be biasing the results.

In order to study the evolution of the effect as years go by relative to the conflict onset, Table 5 reports the summary statistics of the effect by year. Note that the summary statistics are calculated by inputing a non-significant effect as a zero, thus as the years go by the 90th quantile and even the 75th one are equal to zero, because a large number of conflicts cease to have an effect. However, the reported N denotes those that do have a non-zero (i.e. significant) effect. In the year the conflict begins and the next one or two the effect seems to be more constant and smaller, but as time goes on, the distribution spreads out –meaning the effect becomes more and more heterogeneous– and the mean shifts to the left. Overall, the tendency is for the conflict to become more heterogeneous and a larger negative effect in the years 0-2, then slowly increase until years 6-7, where it peaks and by year 9 returns to levels of year 5. Figure 8 plots the estimated kernel density function of the effect for some of the years, where we can better observe the effect described. This heterogeneity in

the effect could be a byproduct of many different variables: type of conflict, continent, or intensity. It could also be argued that, due to unknown circumstances, some armed conflict episodes affect the growth path in such a way that the country recovers "quickly" and returns to its original growth path (i.e. the effect is only temporary) whereas other countries are permanently affected by conflict, and their growth path is irrevocably changed. Of course, the underlying causes for these two types of effect should be explored further.

In order to try to explain part of this heterogeneity of the effect, besides checking the annual evolution since onset of the effect of conflict, we also break down the effect of conflict by other characteristics, such as type or continent. Figure 9 shows the effect of conflict on real GDP per capita by conflict type. We can observe how the last two types of conflict have a more negative effect than the first two, as one would expect. Extrasystemic and Interstate conflicts happen at least in part outside the country's territory, thus the effect is on average lower than the Internal ones. However, one still observes a lot of heterogeneity in the effect of conflict, even when accounting for the type. Notice that there does not seem to be a strong difference between Internal conflicts with and without external intervention; thus from a policy perspective, external intervention does not seem to help the conflicted economy when it comes to economic recovery. These results were to be expected given the definition of each conflict type, and add credibility to the procedure.

As a measure of the internal validity of the analysis carried out, Figure 10 depicts the effect of conflict broken down by intensity. The effect is unmistakably larger in absolute value, as one would expect, as the level of intensity increases. Note that the information about the intensity of conflict is not used when estimating the GDP gap. Thus, the fact that the estimated gaps correlate positively with the intensity adds internal validity to our estimates.

Another important characteristic of the conflicts considered is in what continent do conflicts happen. Figure 11 plots the effect of conflict on real GDP by continent, taking into account the intensity as well. Not only are there significantly more conflicts in Africa than in any other continent, but the intensity of the african wars is higher as well.

6 The distribution of the effect of conflict on Investment

Though the economic costs of conflict are typically measured on real GDP, as we have done so far, the effect of wars on other macroeconomic variables are not without importance. Investment, especially, is a variable that is wildly affected by conflict given the lack of confidence of investors when such episodes happen (Abadie and Gardeazabal, 2008). Therefore, we repeat the analysis carried out in the previous section in order to obtain a measure of the distribution of the effect of conflict on Investment as well.

Like in the case of the real GDP p.c., we apply the synthetic control method to the same 82 conflicts, constructing a synthetic control and carrying out a placebo study for each one of them.[8] Again, we do the matching on the pre-treatment values of investment and we measure the effect of the conflict on the post-treatment values of investment.

Thus, a synthetic control is calculated for 81 conflicts; out of which 30 are discarded because they have a high MSPE and are therefore a bad match. For the remaining 51 conflicts with a good match, a placebo study is carried out with the corresponding controls

[8] We encountered some data problems with Nicaragua and it was not possible to obtain a synthetic control for it, so in the case of investment we end up with 81 applications instead of 82.

and it is determined whether the conflict has a significant effect or not; 31 significant conflicts remain for our analysis. Table 4 lists all the conflicts to which the method is applied (the same ones as the case of real GDP per capita except Nicaragua), together with the date of the conflict onset, the duration of the pre- and post- treatment periods, the type of conflict, the intensity, whether the match on investment was good or not, and whether the effect of conflict on investment is found to be significant or not according to the placebo studies. The significance is determined in the same way as in the previous section. Note that both the proportion of good matches and of significant conflicts is smaller than for the real GDP per capita, which is probably due to the fact that investment is very volatile, i.e. harder to capture in the synthetic control than a smooth trend.

Once again, the difference between the actual log Investment and the estimated counterfactual for the conflicts that have a good synthetic control match and are significant are computed and plotted in Figure 12. The interpretation is the same as before: for each country, the conflict onset is considered period zero, and the number of years is measured relative to the conflict onset. Given that the data is measured in international dollars from 1996, we are able to compare the gaps across countries; however, a loss of for example 1000 1996 international dollars is not the same for all countries, so the relative gaps – measured at each year as the actual Investment minus the counterfactual Investment divided by the actual Investment times 100 – are also calculated and shown in Figure 13. Although the scale is obviously different, the distribution of the effect of conflict on real GDP p.c. and on investment is quite similar, as seen if we directly compare Figures 6 and 13: the majority have an increasingly negative effect as time goes by. Conflict does seem to affect investment quicker than it does real GDP p.c., probably because investors lose confidence and pull investments quickly, even before the first death happens. Unlike in the case of the effect on real GDP

per capita, none of the cases has a positive effect.

Furthermore, from Figures 6 and 13 we can see that the relative effect on investment is much larger than for real GDP per capita. This was to be expected, given that in some conflicted countries, the level of investment was probably low to begin with, and plummeted as a consequence of the lack of confidence from foreign investors armed conflict brings forth and that is crucial to maintain a certain level of investment.

Table 6 reports the summary statistics of the effect by year, calculated in the same way as for the effect on GDP. This can also be observed in Figure 14, which plots the density function of the effect for some of the years. The pattern is similar to the one observed for the case of real GDP p.c.; as time goes on, the distribution spreads out, the effect becomes increasingly heterogeneous and the mean shifts to the left, although the effect does appear to increase faster in the case of investment.

Like in the previous section, Figure 16 serves as a measure of the internal validity of the method. As one would expect, as the intensity of the conflict increases the size of the effect in absolute terms appears to do the same; however, this is not as clear-cut as in the case of GDP. Some low intensity conflicts appear to have larger effects. This is also reasonable, as less-intense conflicts (in terms of deaths) such as terrorist ones are known to have a negative effect on foreign investment (Abadie and Gardeazabal, 2008). Figure 15 shows the effect of conflict on real GDP per capita by conflict type. In this case there are not enough significant conflicts of each type to come to a clear conclusion; however, it does appear that once again Internal conflicts, especially without external intervention, have on average a more negative effect. When we divide the plots by continent and taking into account the intensity of the conflict, as shown in Figure 17, once again we see that there are more conflicts and of a

larger intensity in Africa. The difference in the number of cases per continent is not as large as before, but if we check Table 4 we see that this is mainly because no good matches were found for a lot of African conflicts; and thus they are deemed not significant and not included in the plot.

7 Conclusions

By means of two comparative case studies and a broader application, this paper shows how the synthetic control method can be used to assess the economic effect of armed conflict. As one might expect, wars fought outside of the territory have a smaller impact than internal conflicts. The conflicts that happen in Africa are of greater intensity on average and lead to a bigger loss in terms of real GDP per capita and investment.

The distribution of the effect obtained for real GDP per capita and investment are somewhat similar: the vast majority have an increasingly negative effect as time goes by, though the effect grows at a faster rate in the case of investment. Furthermore, the effect seems to be very persistent in some cases, as if the country's growth path has changed; whereas others seem to rebound more quickly, as seen in the evolution of the density function per year (i.e. with time the distribution seems to spread out). The results we have obtained are consistent in terms of the internal validity check conducted using the data on intensity. Also, given the wide range of effects obtained when estimating the distribution of the effect, we can conclude that estimating the effect of conflict should be done on a case-by-case basis, and therefore the synthetic control method is a good candidate.

Furthermore, by conducting the analysis using GDP levels instead of growth rates we are

able to observe a loss in GDP in the post-conflict period, even when there is a peace dividend effect that improves the nation's economy; a loss that, if only considering growth rates, would be missed by the researcher. Moreover, by using this quasi-experimental approach we are able to provide a causal interpretation of the results, i.e. the effect measured is indeed due to the armed conflict episode.

This paper illustrates a procedure to estimate the distribution of a treatment effect. By applying the synthetic control method to the universe of armed conflict episodes that took place over the last decades, we are able to estimate the distribution of the economic effect of armed conflict and therefore asses how heterogeneous the effects really are, as opposed to traditional average treatment effect methodologies.

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Table 1 Pre-treatment values of covariates for Sierra Leone and Israel

Sierra Leone				
Predictors	Actual	Synthetic	Sample Mean	Predictor Weights
Investment share	11.075	34.671	28.885	0.000
Degree of openness	39.252	48.068	84.946	0.001
Primary educ. attain.	8.785	8.760	24.897	0.132
Secondary educ. attain.	1.550	2.423	16.560	0.043
Population Density	0.049	0.047	0.492	0.010
log real GDP p.c.	6.919	6.920	8.965	0.805
MSPE (1970-1990)		0.040		
Israel				
Predictors	Actual	Synthetic	Sample Mean	Predictor Weights
Investment share	31.639	24.286	23.262	0.000
Degree of openness	31.564	31.374	35.680	0.010
Primary educ. attain.	38.078	37.470	40.531	0.003
Secondary educ. attain.	14.859	14.825	13.501	0.079
Population Density	0.071	0.134	0.082	0.000
log real GDP p.c.	8.924	8.924	9.265	0.908
MSPE (1957-1964)		0.001		

All predictors are averaged over the entire pre-treatment period. The MSPE is defined as the squared deviations between the outcome for the treated unit and the synthetic control unit summed over all pre-intervention periods.

Table 4 Conflict Episodes Used for the Estimate of the Distribution of the Effect

							real GDP		Investment	
Country	Onset	Pre-tr	Post-tr	Type	Intens.	Continent	Match	Signif.	Match	Signif.
Afghanistan	1978	8	9	Extrasystemic	7	Asia	Yes	·	Yes	·
Algeria	1990	10	9	InternalInt	4	Africa	Yes	*	Yes	*
Angola	1975	5	9	InternalExt	6	Africa	Yes	*	Yes	*
Argentina	1955	5	9	InternalInt	2	America	Yes	·	Yes	*
Bangladesh	1975	10	9	InternalInt	2	Asia	No		No	
Bolivia	1967	10	9	InternalInt	2	America	Yes	*	No	
Burkina Faso	1985	10	9	Interstate	1	Africa	No		No	
Burundi	1965	5	9	InternalInt	2	Africa	No		No	

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Table 4 – continued from previous page

							real GDP		Investment	
Country	Onset	Pre-tr	Post-tr	Type	Intens.	Continent	Match	Signif.	Match	Signif.
Central African Rep.	2001	10	8	InternalExt	1	Africa	Yes	*	No	
Chad	1966	6	9	InternalExt	4	Africa	Yes	*	Yes	*
Chile	1973	10	9	InternalInt	2	America	Yes	*	No	
China	1974	10	9	Interstate	4	Asia	Yes	*	Yes	·
Colombia	1975	10	9	InternalInt	4	America	Yes	*	Yes	·
Comoros	1989	10	9	InternalInt	3	Africa	Yes	*	Yes	*
Congo	1993	10	9	InternalExt	1	Africa	Yes	*	No	
Cyprus	1974	10	9	Extrasystemic	2	Europe	Yes	*	Yes	*
DR Congo (Zaire)	1963	10	9	InternalInt	5	Africa	No		No	
Djibouti	1991	10	9	InternalInt	1	Africa	Yes	*	No	
Dominican Rep.	1965	10	9	InternalInt	2	America	Yes	*	No	
Ecuador	1995	10	9	Interstate	1	America	Yes	*	Yes	*
Egypt	1992	10	9	InternalInt	1	Africa	Yes	*	No	
El Salvador	1979	10	9	InternalInt	6	America	Yes	*	Yes	*
Eritrea	1998	6	9	Interstate	5	Africa	No		No	
Ethiopia	1960	10	9	InternalInt	1	Africa	No		No	
Gabon	1964	4	9	InternalInt	2	Africa	Yes	·	Yes	*
Gambia	1981	10	9	InternalExt	1	Africa	Yes	·	No	
Ghana	1981	10	9	InternalInt	1	Africa	No		No	
Grenada	1983	10	9	Interstate	1	America	No		No	
Guatemala	1954	4	9	InternalInt	1	America	Yes	*	No	
Guinea	2000	10	9	InternalInt	1	Africa	Yes	·	Yes	·
Guinea-Bissau	1998	10	9	InternalExt	2	Africa	No		No	
Haiti	1989	10	9	InternalInt	1	America	Yes	*	Yes	*
Honduras	1957	7	9	Interstate	1	America	No		No	
Indonesia	1965	5	9	InternalInt	2	Asia	Yes	*	Yes	·
Israel	1965	10	9	Interstate	3	Asia	Yes	*	Yes	*
Ivory Coast	2002	10	7	InternalInt	2	Africa	Yes	*	No	
Kenya	1982	10	9	InternalInt	2	Africa	Yes	*	Yes	·
Laos	1975	5	9	InternalInt	2	Asia	No		Yes	·
Lesotho	1998	10	9	InternalExt	1	Africa	Yes	*	Yes	*
Liberia	1980	10	9	InternalInt	2	Africa	Yes	*	Yes	*
Macedonia	2000	10	9	InternalInt	1	Europe	Yes	*	Yes	*
Madagascar	1971	10	9	InternalInt	5	Africa	Yes	*	Yes	*
Mali	1990	10	9	InternalInt	1	Africa	No		Yes	*
Mauritania	1975	10	9	InternalInt	3	Africa	Yes	*	Yes	·
Mexico	1994	10	9	InternalInt	1	America	Yes	*	Yes	*
Morocco	1975	10	9	Extrasystemic	3	Africa	Yes	.	Yes	·
Mozambique	1977	10	9	InternalExt	6	Africa	No		Yes	·
Nepal	1996	10	9	InternalInt	2	Asia	Yes	*	Yes	*
Nicaragua	1977	10	9	InternalInt	3	America	Yes	*		
Niger	1991	10	9	InternalInt	1	Africa	No		No	
Nigeria	1966	10	9	InternalInt	3	Africa	Yes	*	No	
Pakistan	1973	10	9	Interstate	2	Asia	Yes	*	Yes	*
Panama	1989	10	9	Interstate	1	America	Yes	·	Yes	*
Papua New Guinea	1989	10	9	InternalInt	1	Asia	Yes	*	Yes	*
Paraguay	1989	10	9	InternalInt	1	America	Yes	*	Yes	*
Peru	1982	10	9	InternalInt	3	America	Yes	*	Yes	·
Portugal	1961	10	9	Extrasystemic	1	Europe	Yes	·	Yes	·
Romania	1989	10	9	InternalInt	1	Europe	Yes	*	Yes	*
Russia	1994	4	9	InternalInt	4	Asia	Yes	*	Yes	*
Rwanda	1990	10	9	InternalExt	7	Africa	No		No	
Saudi Arabia	2003	10	6	InternalExt	1	Asia	Yes	*	Yes	·
Senegal	1989	10	9	Interstate	1	Africa	Yes	·	Yes	*
Sierra Leone	1991	10	9	InternalInt	7	Africa	Yes	*	No	
Somalia	1981	10	9	InternalInt	5	Africa	No		Yes	·
South Africa	1966	10	9	Extrasystemic	1	Africa	Yes	*	Yes	·

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Table 4 – continued from previous page

							real GDP		Investment	
Country	Onset	Pre-tr	Post-tr	Type	Intens.	Continent	Match	Signif.	Match	Signif.
Spain	1957	7	9	Extrasystemic	1	Europe	Yes	·	Yes	·
Sri Lanka	1971	10	9	InternalInt	2	Asia	Yes	∗	Yes	∗
Suriname	1986	10	9	InternalInt	1	America	Yes	∗	No	
Syria	1967	7	9	Interstate	4	Asia	Yes	∗	Yes	∗
Tanzania	1978	10	9	Interstate	2	Africa	No		Yes	·
Thailand	1965	10	9	InternalExt	2	Asia	Yes	·	Yes	∗
Togo	1986	10	9	Interstate	1	Africa	Yes	·	No	
Trinidad & Tobago	1990	10	9	InternalInt	1	America	Yes	·	No	
Tunisia	1980	10	9	InternalInt	3	Africa	Yes	∗	Yes	·
Turkey	1980	10	9	InternalInt	2	Asia	Yes	∗	Yes	·
Uganda	1971	10	9	InternalInt	6	Africa	Yes	∗	Yes	∗
United Kingdom	1970	10	9	InternalInt	1	Europe	Yes	∗	Yes	∗
United States	2001	10	8	Interstate	2	America	Yes	∗	Yes	·
Uruguay	1972	10	9	InternalInt	2	America	Yes	∗	Yes	∗
Uzbekistan	1999	9	9	InternalExt	1	Asia	Yes	·	No	
Venezuela	1962	10	9	InternalInt	1	America	Yes	·	No	
Zimbabwe	1962	8	9	InternalExt	3	Africa	No		No	

Pre-treatment and post-treatment columns refer to the duration in years. Significance is specified for those that have a good match only: $*$ is significant according to the placebo studies for at least some time periods, $\cdot$ is not significant for any period.

Table 2 Country weights in the synthetic controls of Sierra Leone and Israel

Country	Sierra Leone	Israel	Country	Sierra Leone	Israel
Albania	0.001		Jamaica	0.001	
Australia	0.000	0.017	Japan	0.000	0.381
Austria	0.000	0.015	Jordan	0.001	
Bahrain	0.000		Korea	0.001	
Barbados	0.000		Luxembourg	0.000	0.099
Belgium	0.000	0.019	Macao	0.001	
Belize	0.001		Malawi	0.292	
Benin	0.641		Maldives	0.000	
Botswana	0.001		Malta	0.001	
Brazil	0.037	0.174	Mauritius	0.000	
Brunei	0.000		Mongolia	0.000	
Bulgaria	0.001		Namibia	0.001	
Canada	0.000	0.011	New Zealand	0.000	0.007
Denmark	0.000	0.012	Norway	0.000	0.070
Fiji	0.001		Poland	0.001	
Finland	0.000	0.033	Singapore	0.001	
Germany	0.000		Swaziland	0.001	
Guyana	0.001		Sweden	0.000	0.013
Iceland		0.075	Switzerland	0.000	0.015
Ireland		0.013	Taiwan	0.001	
Italy	0.000	0.046	Tonga	0.001	
			Zambia	0.011	

Countries that have a weight or coefficient equal to zero are included in the subset of possible controls, whereas those that do not have any weight or coefficient have not been considered as possible controls.

Table 3 Log real GDP p.c. gap in levels and growth rates

		Real GDP p.c. gap	Growth rate gap
Sierra Leona			
1971-1990	Pre-conflict	−4.587	−0.233
		(−0.45)	
1991-1999	Conflict	−264.498	−7.964
		(−35.45)	
2000-2009	Post-conflict	−345.431	5.250
		(−47.39)	
1991-2009	Total effect; conflict & post-conflict	−307.094	−1.009
		(−41.67)	
1999	Maximum gap	−545.053	−10.395
		(−107.10)	
Israel			
1958-1964	Pre-conflict	2.112	−0.031
		(0.03)	
1965-1967	Conflict	−740.733	−4.549
		(−7.97)	
1968-1970	Post-conflict	−369.886	4.139
		(−3.17)	
1965-1970	Total effect; conflict & post-conflict	−555.310	−0.205
		(−5.30)	
1967	Maximum gap	−1385.540	−5.504
		(−15.14)	

Real GDP p.c. gap is shown in levels and as a percentage of the actual real GDP p.c. in parenthesis underneath. Growth rate gap is shown in percentage points. All measures are an annual average over the specified period.

Table 5 Summary statistics for the effect of conflict on real GDP p.c., by year, relative to conflict onset.

	N	Mean	St. Dev	10th Pctl	25th Pctl	Median	75th Pctl	90th Pctl
Conflict onset	43	-7.06	10.96	-19.31	-10.43	-3.81	0.00	1.69
1 year after onset	44	-13.86	14.26	-31.20	-19.39	-10.18	-4.18	0.00
2 years after onset	44	-19.03	18.04	-44.72	-28.50	-13.73	-6.47	0.00
3 years after onset	41	-20.67	18.92	-46.56	-35.59	-18.38	-2.41	0.00
4 years after onset	38	-22.92	21.63	-49.65	-41.26	-19.14	0.00	0.00
5 years after onset	37	-26.13	26.95	-62.71	-42.94	-21.49	0.00	0.00
6 years after onset	36	-30.53	34.82	-78.54	-44.44	-18.48	0.00	0.00
7 years after onset	34	-29.81	33.43	-73.85	-44.56	-23.38	0.00	0.00
8 years after onset	32	-27.97	35.18	-67.77	-44.38	-19.06	0.00	0.00
9 years after onset	30	-26.65	34.93	-61.92	-39.41	-16.17	0.00	0.00

Table 6 Summary statistics for the effect of conflict on Investment, by year, relative to conflict onset.

	N	Mean	St. Dev	10th Pctl	25th Pctl	Median	75th Pctl	90th Pctl
Conflict onset	29	-24.10	62.44	-59.26	-28.90	0.00	0.00	0.00
1 year after onset	30	-35.38	47.04	-94.56	-57.13	-18.98	0.00	0.00
2 years after onset	29	-40.53	64.11	-100.19	-60.86	-15.57	0.00	0.00
3 years after onset	27	-42.59	76.62	-128.68	-63.74	-1.96	0.00	0.00
4 years after onset	24	-55.62	107.69	-145.21	-78.62	0.00	0.00	0.00
5 years after onset	23	-67.09	121.47	-202.44	-88.65	0.00	0.00	0.00
6 years after onset	22	-75.33	125.83	-257.60	-96.08	0.00	0.00	0.00
7 years after onset	22	-83.03	145.68	-264.39	-120.45	0.00	0.00	0.00
8 years after onset	22	-86.39	146.94	-312.79	-92.39	0.00	0.00	0.00
9 years after onset	22	-90.84	166.19	-320.77	-92.47	0.00	0.00	0.00

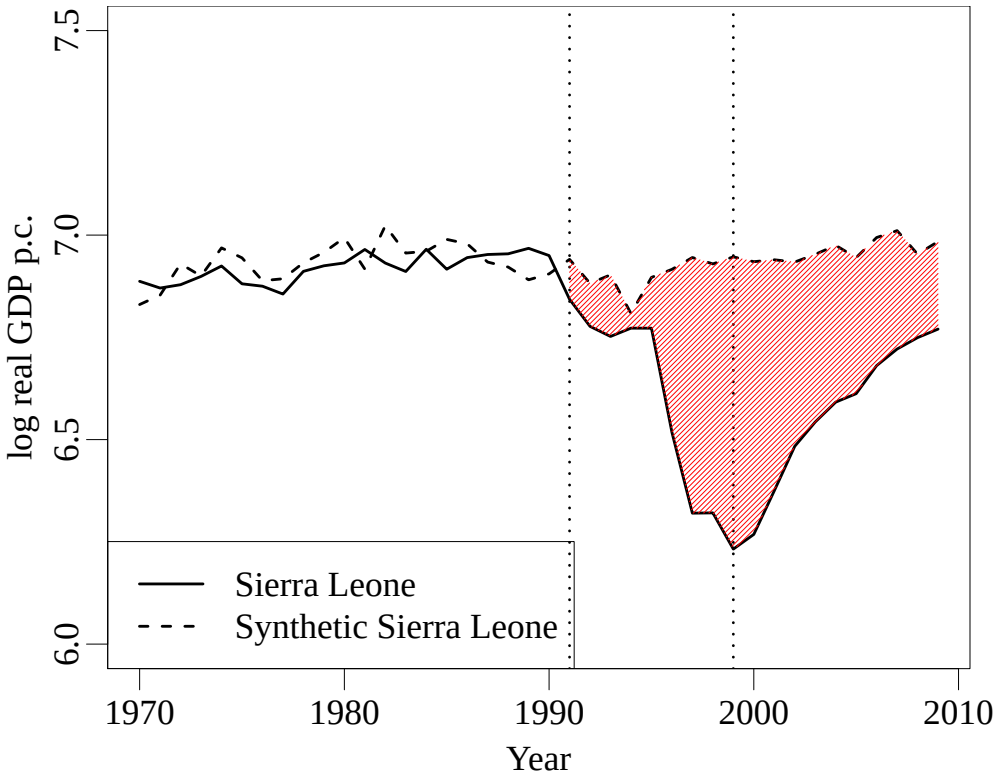


Fig. 1 Actual real GDP per capita and Synthetic Control for Sierra Leone

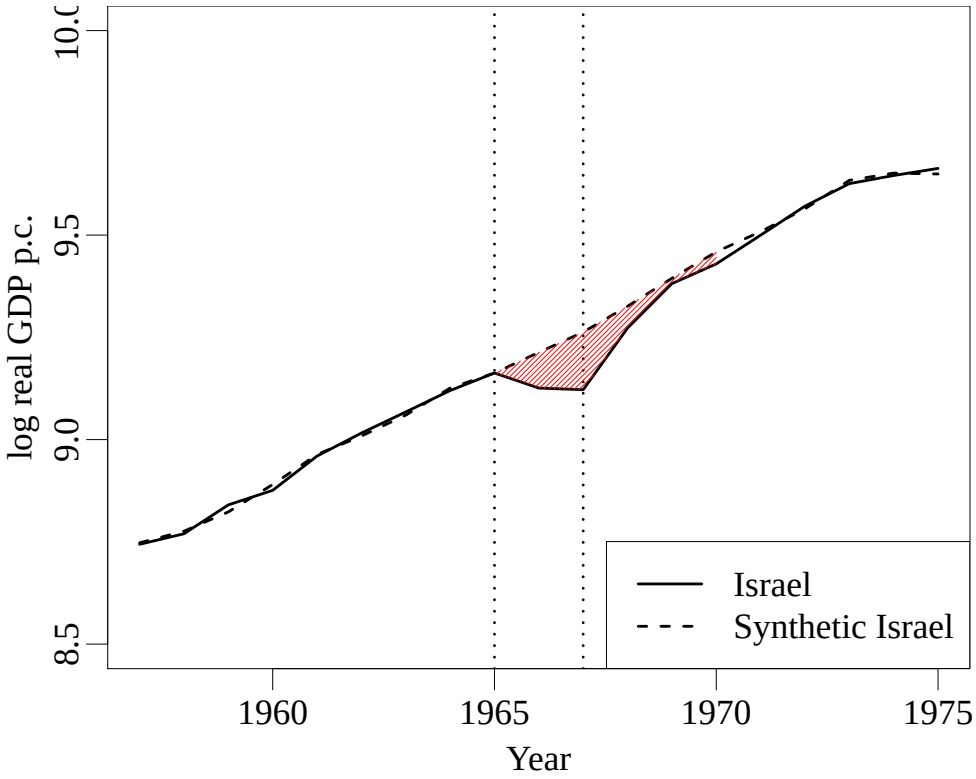


Fig. 2 Actual real GDP per capita and Synthetic Control for Israel

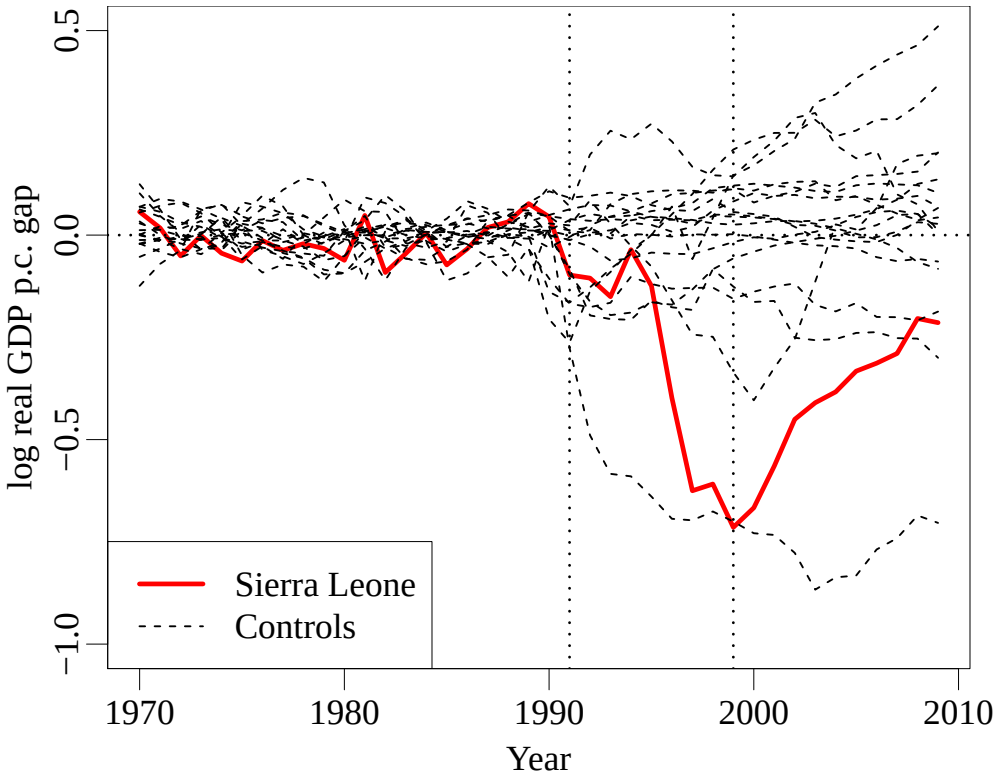


Fig. 3 Placebos for Sierra Leone (17 controls)

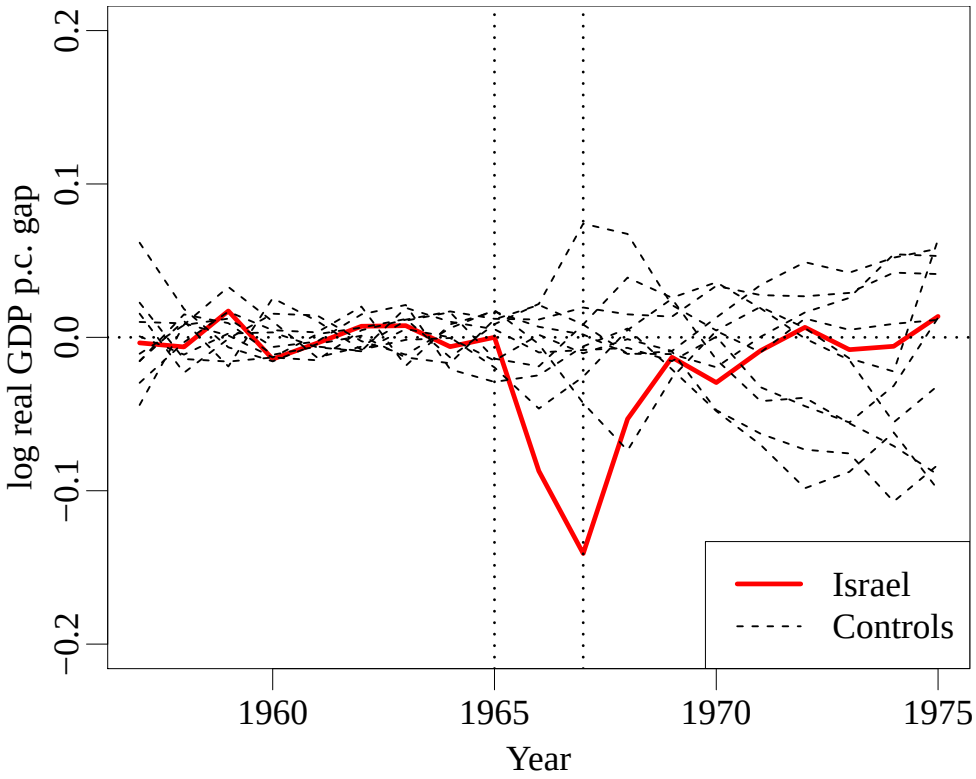


Fig. 4 Placebos for Israel (10 controls)

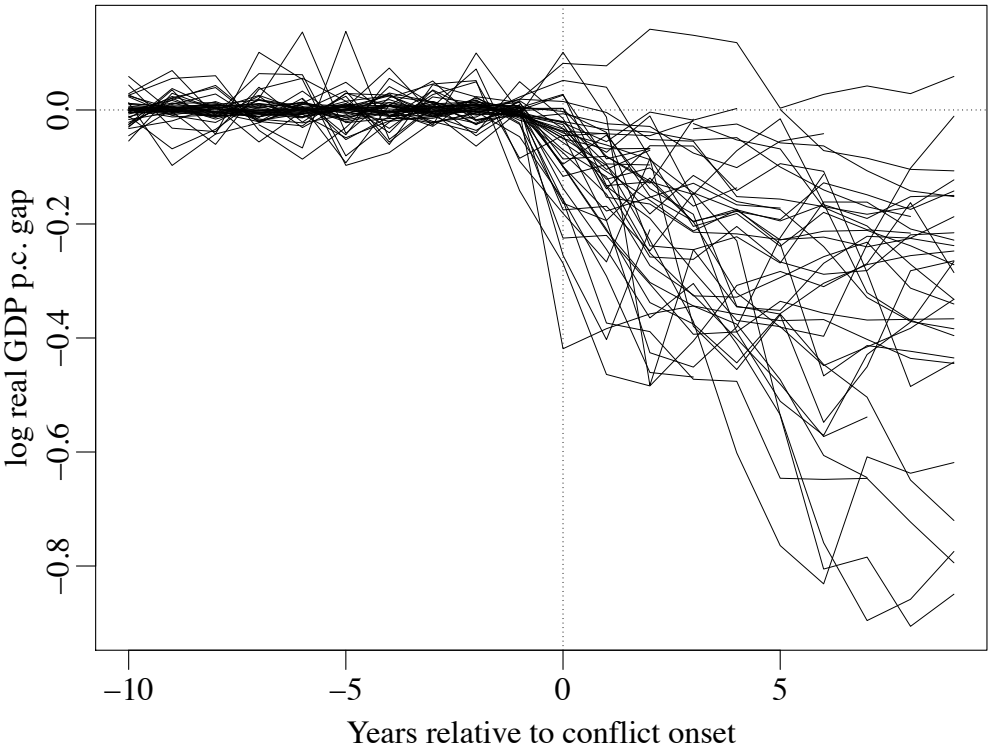


Fig. 5 Estimated log real GDP p.c. gap for 49 significant conflict episodes

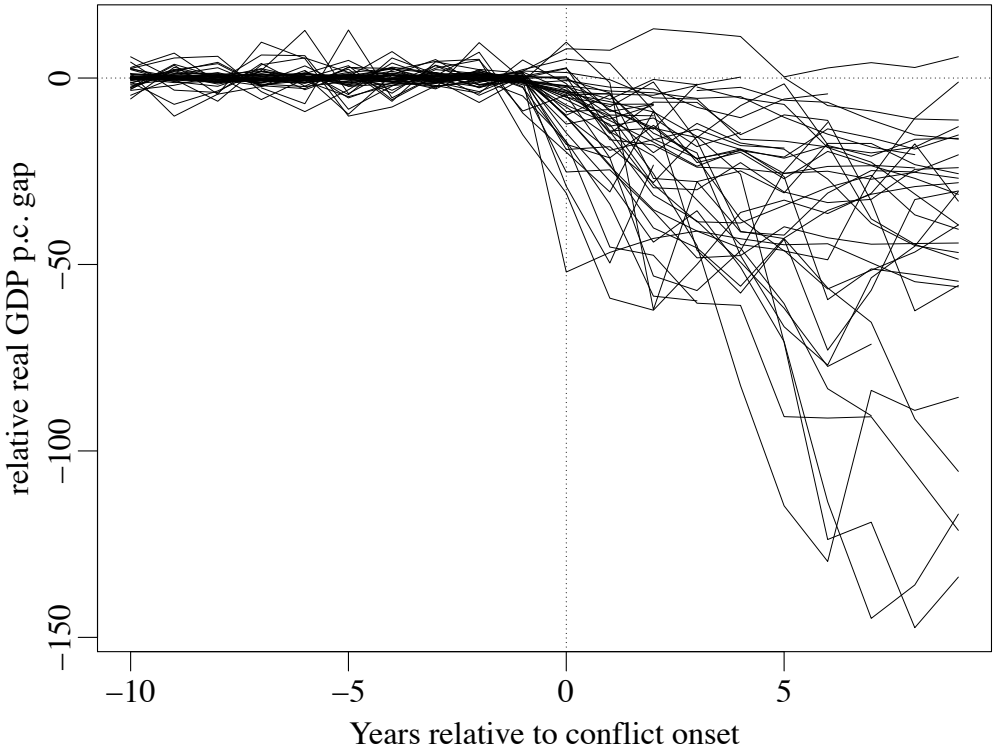


Fig. 6 Estimated relative real GDP p.c. gap for 49 significant conflict episodes

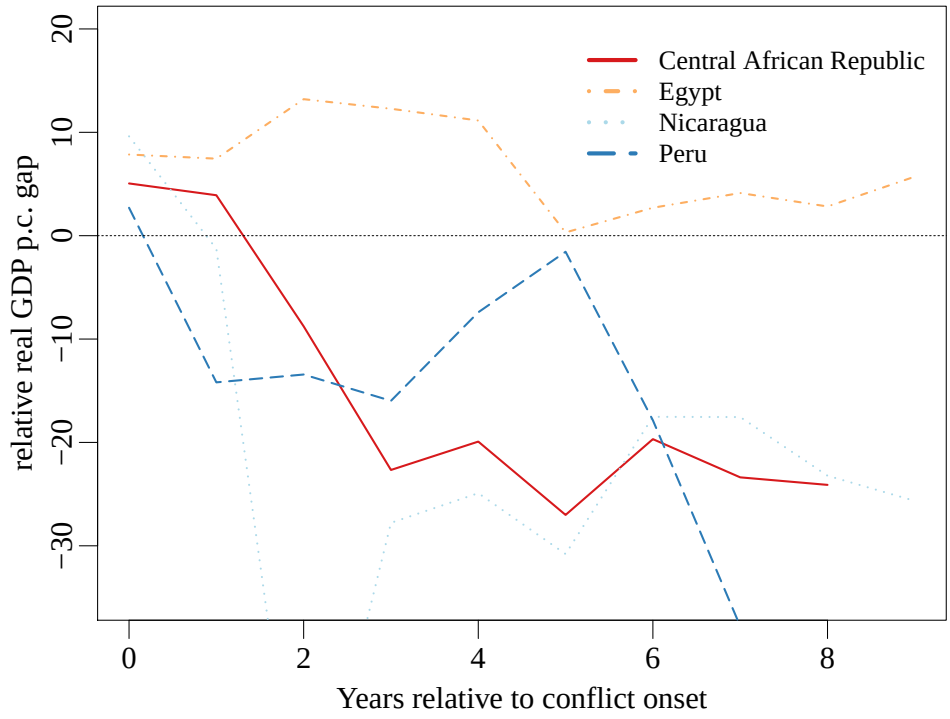


Fig. 7 Estimated relative real GDP p.c. gap for conflict episodes with a positive effect on real GDP p.c.

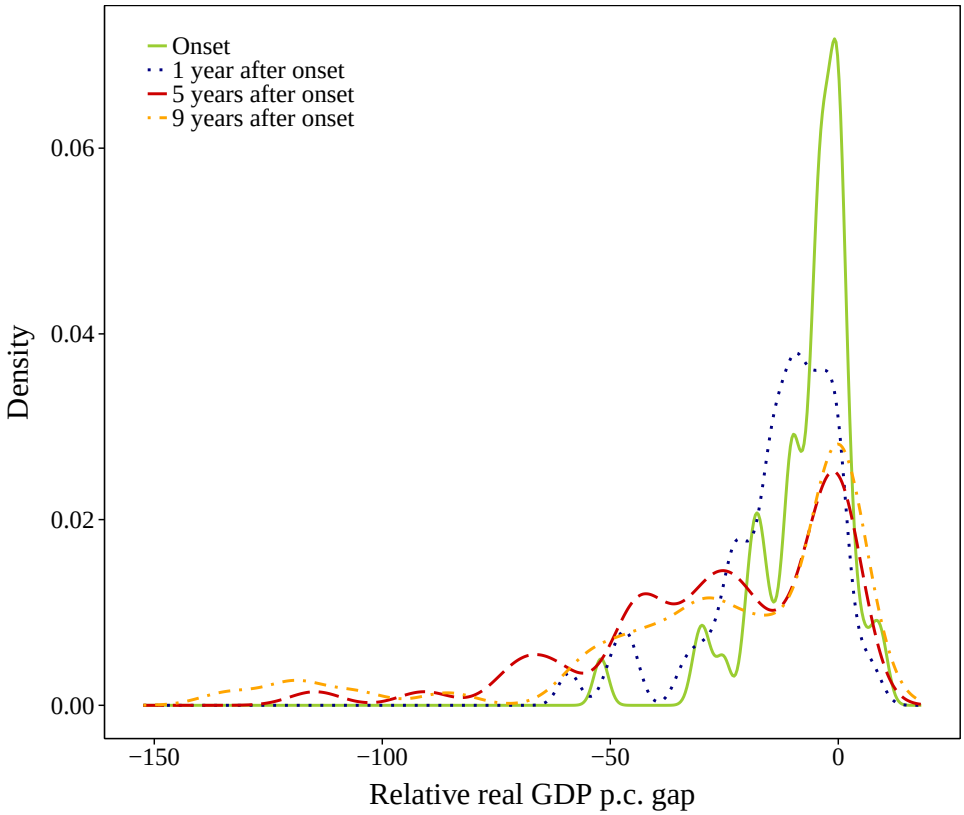


Fig. 8 Distribution of the relative effect of conflict on real GDP p.c. by year

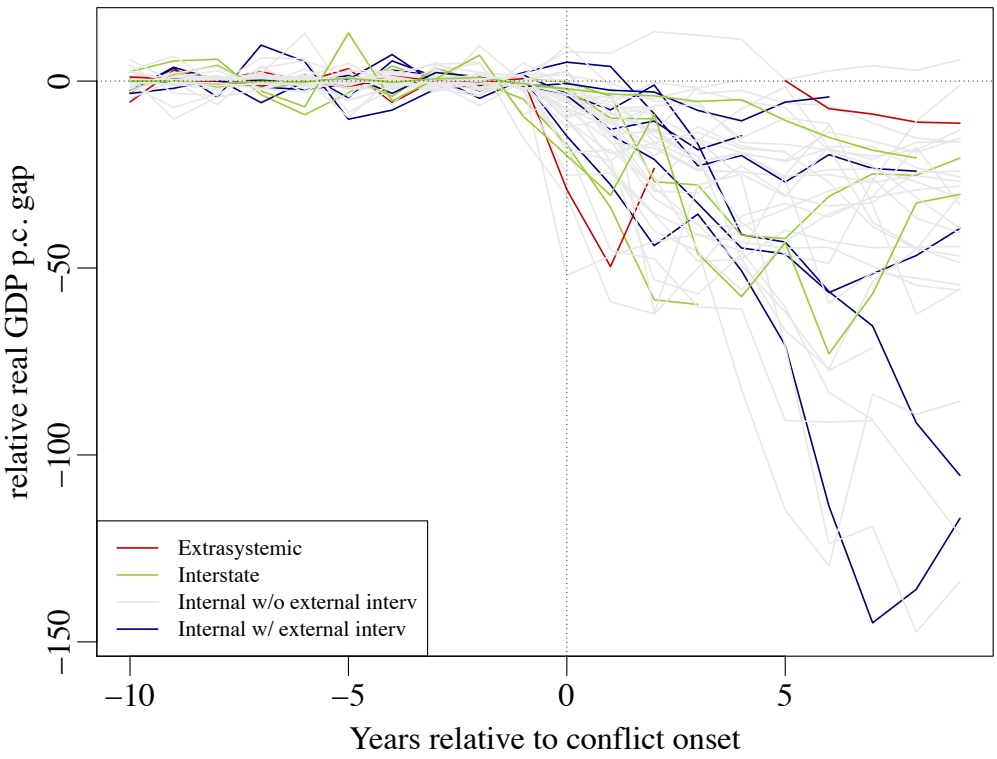


Fig. 9 Estimated relative real GDP p.c. gap for 49 significant conflict episodes, by type of conflict

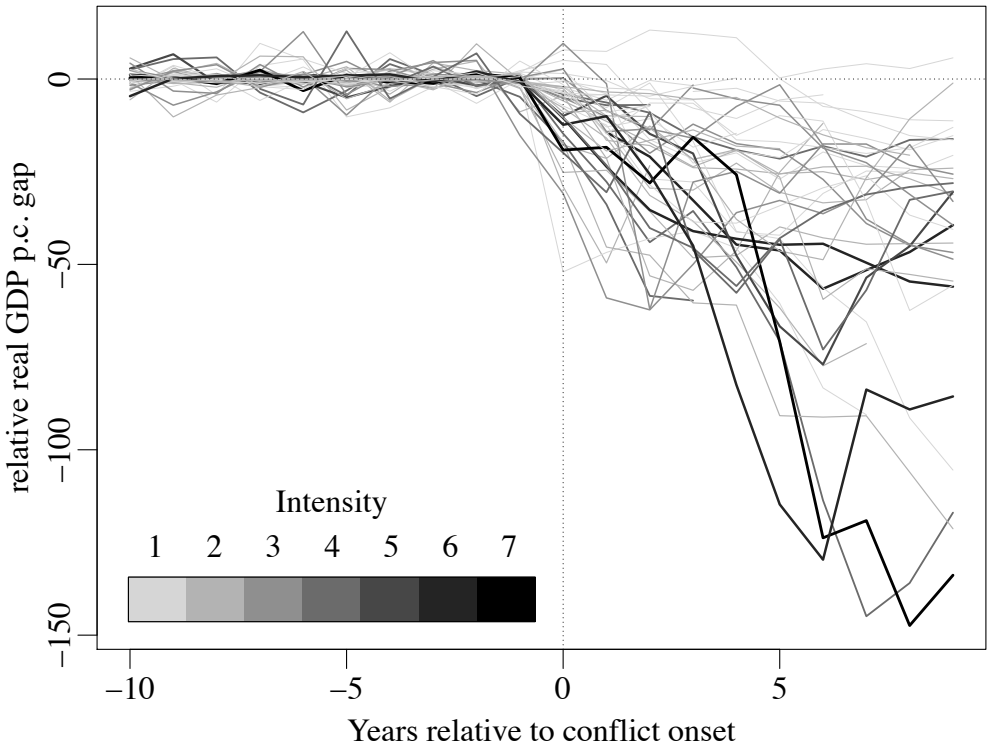
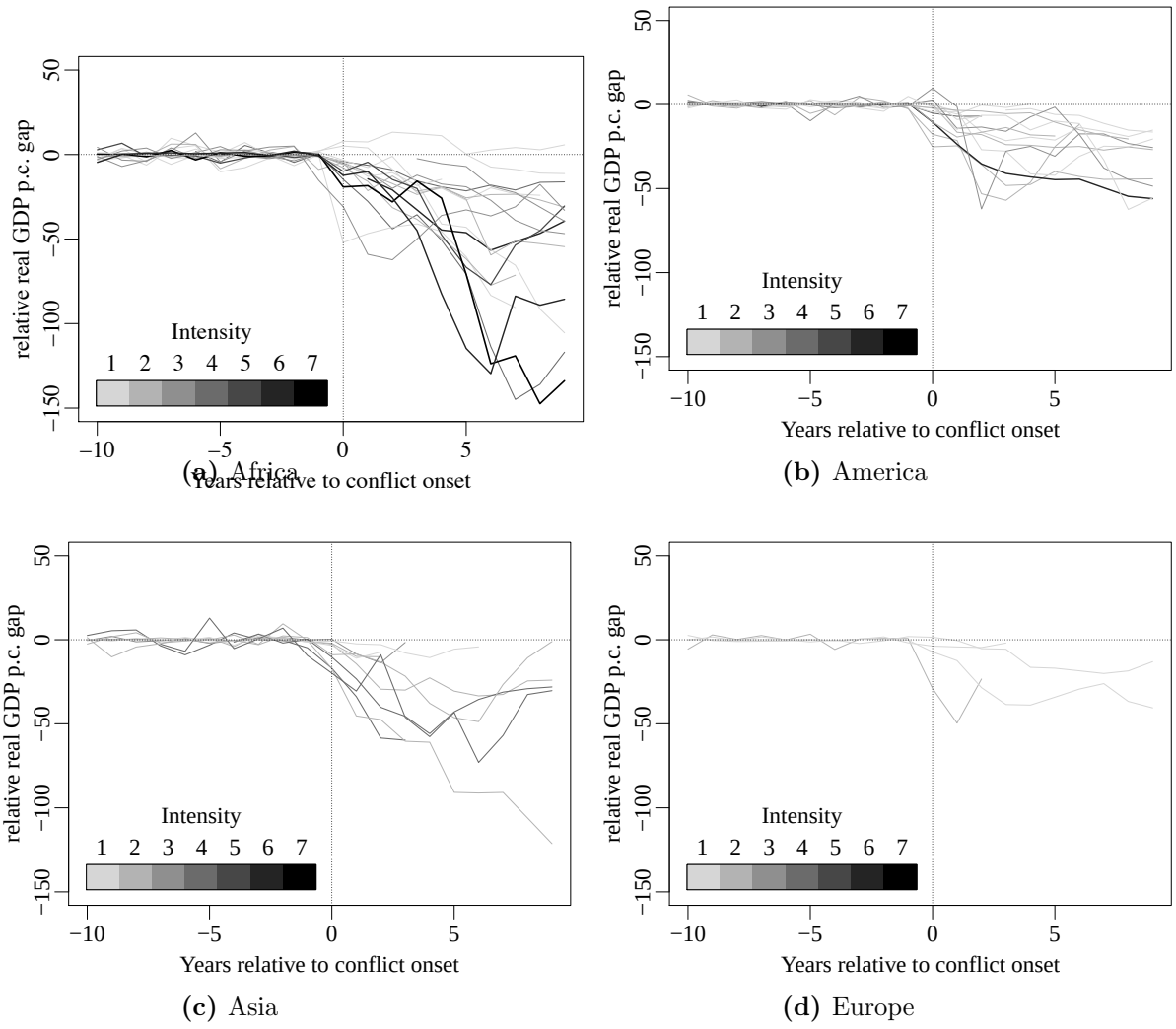


Fig. 10 Estimated relative real GDP p.c. gap for 49 significant conflict episodes, by intensity of conflict



(a) Africa **(b)** America

(c) Asia **(d)** Europe

Fig. 11 Estimated relative log real GDP p.c. gap for 49 significant conflict episodes, by continent.

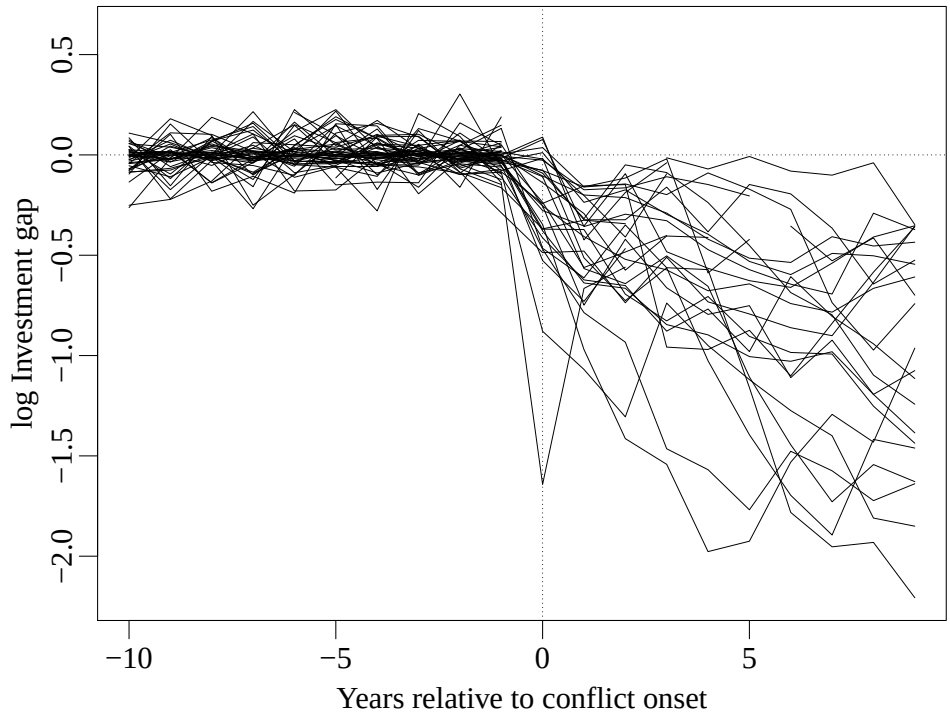


Fig. 12 Estimated log Investment gap for 31 significant conflict episodes

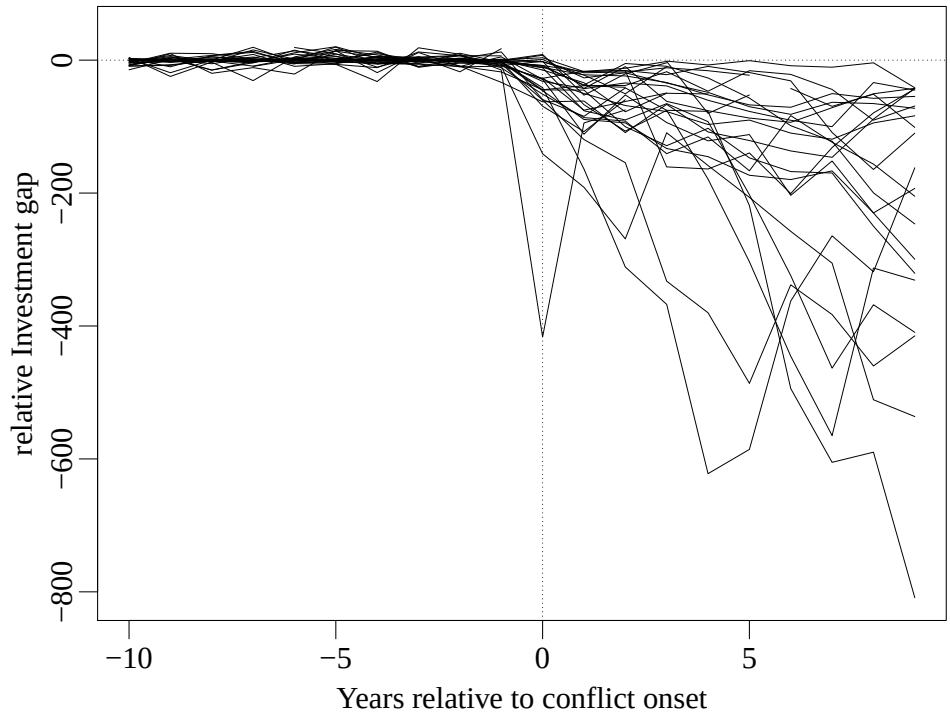


Fig. 13 Estimated relative Investment gap for 31 significant conflict episodes

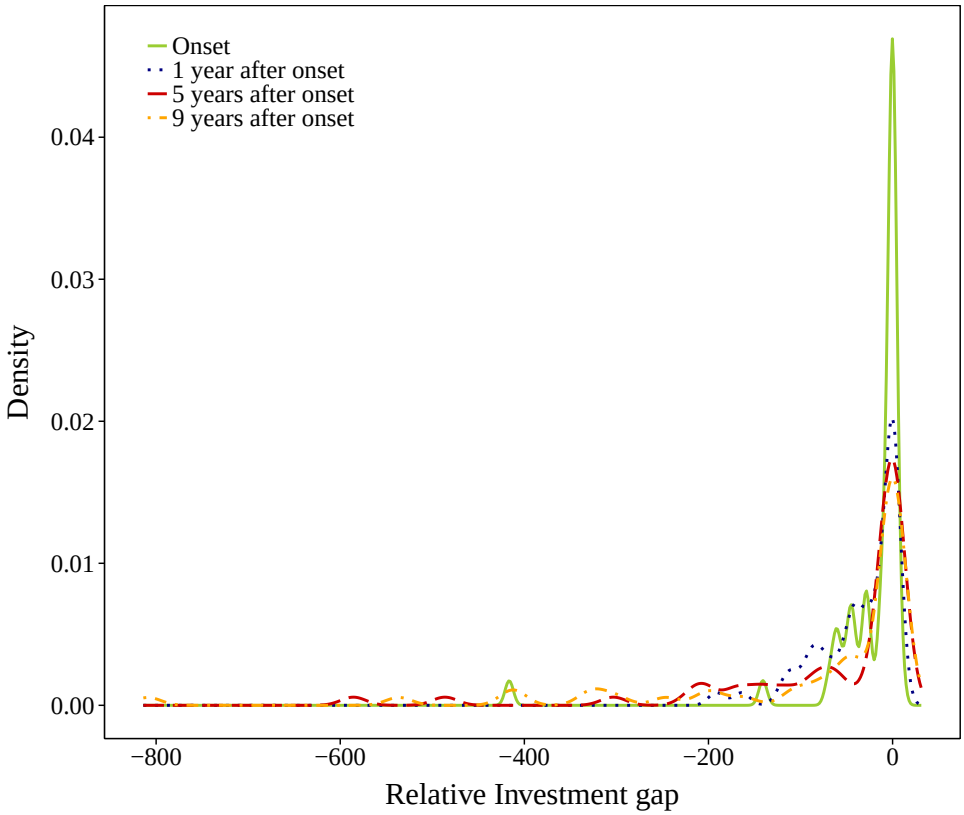


Fig. 14 Distribution of the relative effect of conflict on Investment by year

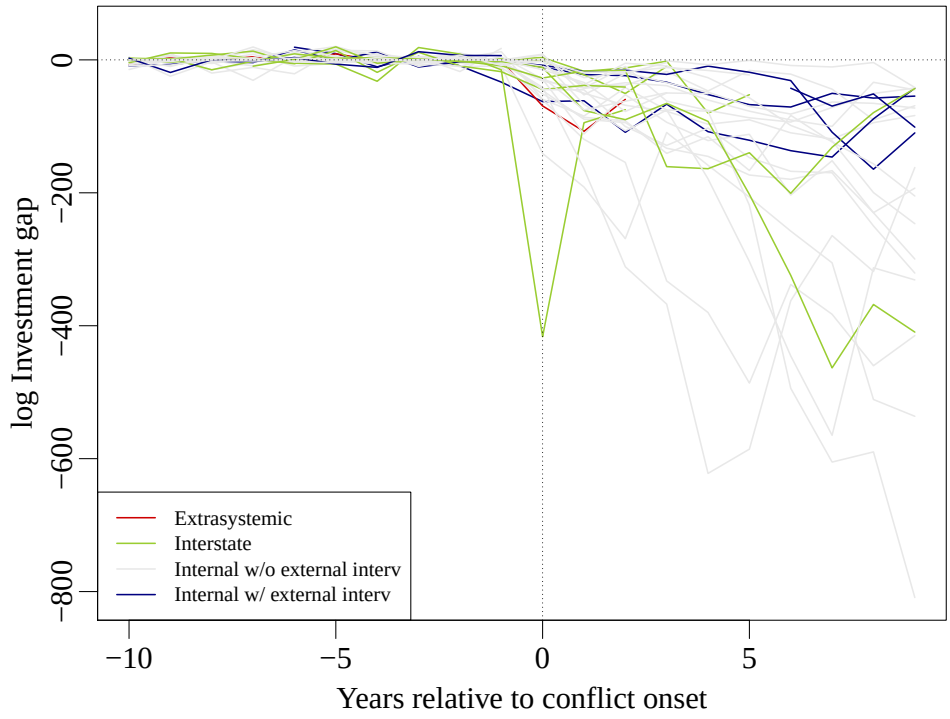


Fig. 15 Estimated relative Investment gap for 31 significant conflict episodes, by type of conflict

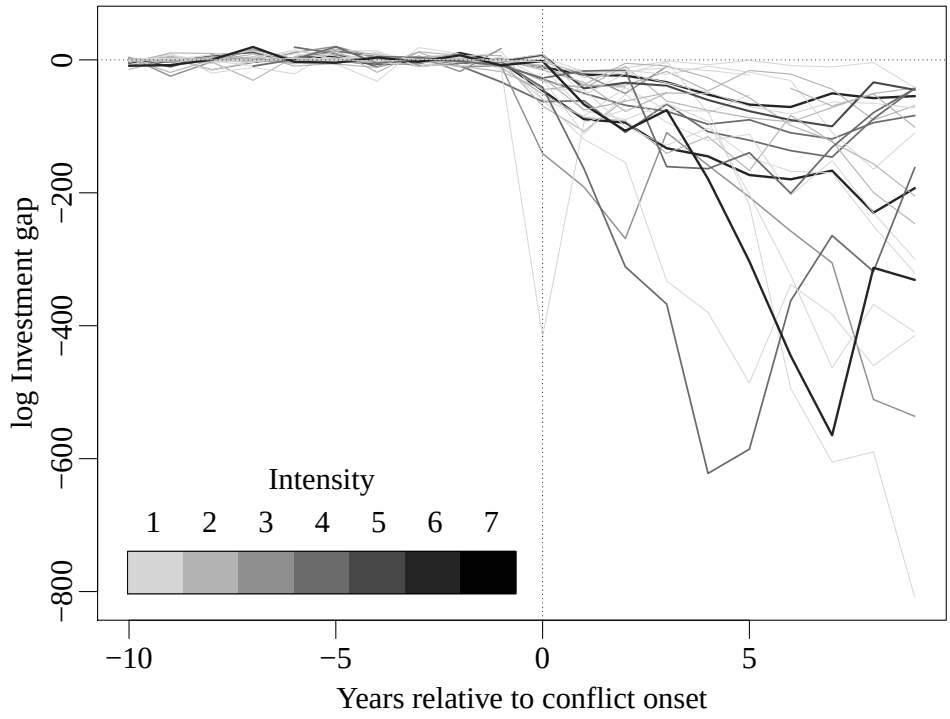
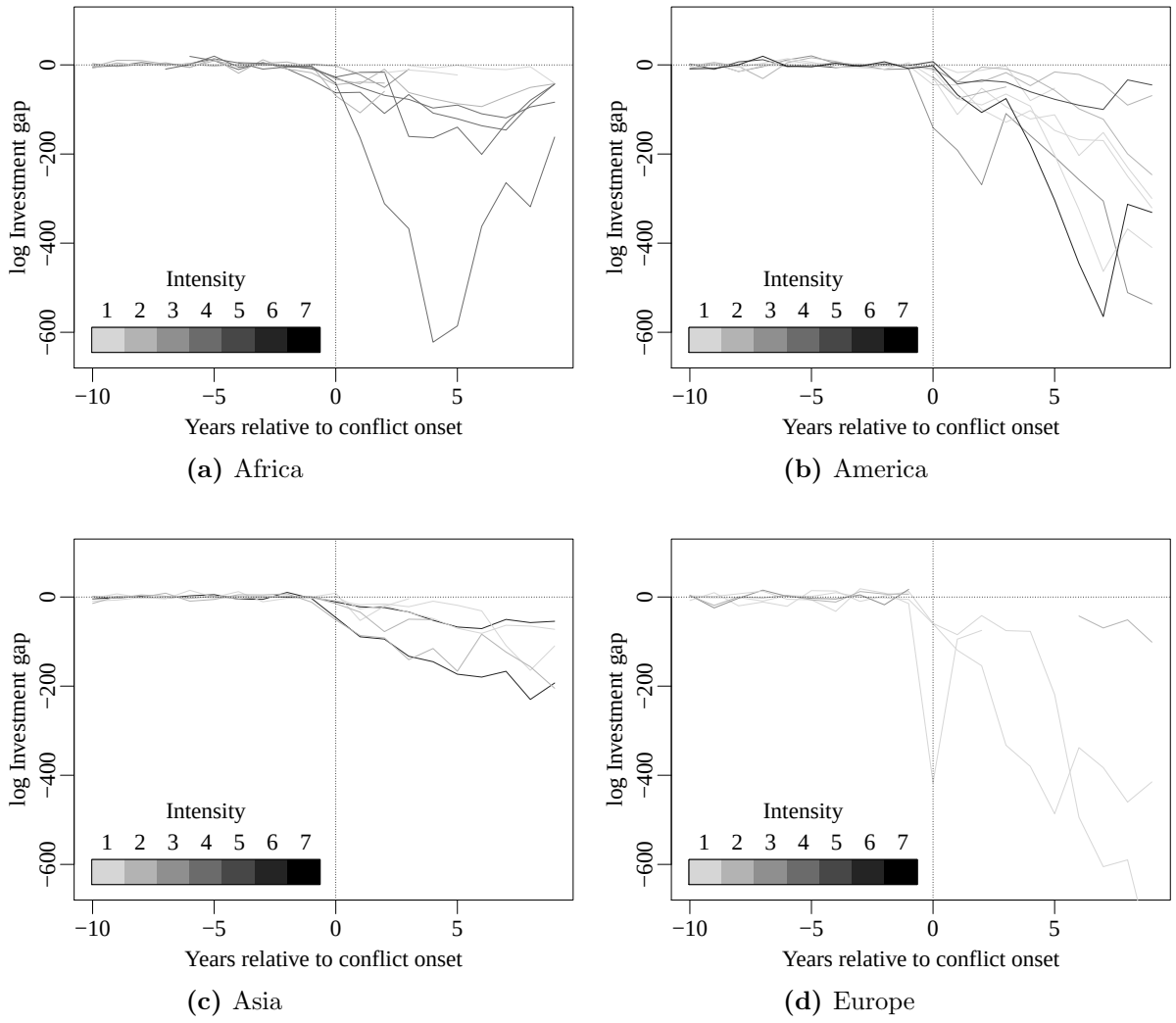


Fig. 16 Estimated relative Investment gap for 31 significant conflict episodes, by intensity of conflict



(a) Africa **(b)** America

(c) Asia **(d)** Europe

Fig. 17 Estimated relative log Investment gap for 31 significant conflict episodes, by continent.

Variable definition and data sources

Degree of Openness Exports plus imports divided by real GDP per capita. It is the total trade as a percentage of real GDP, in constant prices. The export and import figures are in national currencies from the World Bank and United Nations data archives. Panel data that ranges from 1950 to 2009.
Source: PWT 7.0.

Intensity of Conflict A categorical variable coded on a 1 to 10 scale, with 1 being the least intense or damaging ("Sporadic or Expressive Political Violence") and 10 being the most intense ("Extermination and Annihilation"); although conflicts in our sample range from 1 to 7 only. The level of intensity is determined by a series of indicators, which include direct and indirect deaths, injuries, population dislocations, damage to societal networks and infraestructure, destruction of the environment and ecosystem, and other tangible and intagible losses. Check the source for a more comprehensive explanation on how the scale is determined.
Source: Center for Systemic Peace, http://www.systemicpeace.org/warcode.htm..

Investment Share of Real GDP Per Capita Together with Consumption share and Government share of real GDP per capita, one of the three component shares of real GDP per capita. IK is obtained by dividing the investment component by the real GDP per capita (which is, in turn, the sum of the three components mentioned) plus exports and minus imports in 1996 prices. Panel data that ranges from 1950 to 2009.
Source: PWT 7.0.

Population Density People per sq. km of land area. Population density is midyear population divided by land area in square kilometers. Population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship–except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of their country of origin. Land area is a country's total area, excluding area under inland water bodies, national claims to continental shelf, and exclusive economic zones. In most cases the definition of inland water bodies includes major rivers and lakes. Panel data that ranges from 1981 to 2010.
Source: World Bank.

Primary Educational Attainment Percentage of complete primary schooling attained out of population aged 15 years old or higher. Panel data that ranges from 1950 to 2009, observations only available every five years.
Source: A New Data Set of Educational Attainment in the World, 1950?2010 by Robert J. Barro, Jong-Wha Lee; v1.2 BL(2010) MF1599.

Real GDP Per Capita, Laspeyres real GDP per capita is obtained by adding up consumption, investment, government and exports, and subtracting imports in any given year. The given year components are obtained by extrapolating the 1996 values in international dollars from the Geary aggregation using national growth rates. It is a fixed base index where the reference year is 1996, hence the designation "L" for Laspeyeres. Panel data that ranges from 1950 to 2009.
Source: PWT 7.0.

Secondary Educational Attainment Percentage of complete secondary schooling attained out of population aged 15 years old or higher. Panel data that ranges from 1950 to 2009, observations only available every five years.
Source: A New Data Set of Educational Attainment in the World, 1950-2010 by Robert J. Barro, Jong-Wha Lee; v1.2 BL(2010) MF1599.

Type of Conflict A categorical variable that classifies conflict into four different types: Extrasystemic, Interstate, Internal without external intervention (Civil war) or Internal with external intervention. Extrasystemic armed conflict occurs between a state and a non-state group outside its own territory. Interstate armed conflict occurs between two or more states. Internal without external intervention conflict occurs between the government of a state and one or more internal opposition group(s) without intervention from other states. Internationalized internal armed conflict or internal without external intervention occurs between the government of a state and one or more internal opposition group(s) with intervention from other states (secondary parties) on one or both sides.
Source: UCDP/PRIO Armed Conflict Dataset v.4-2011.